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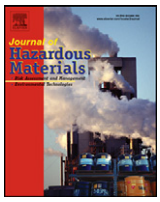

Hazardous waste management and weight-based indicators—The case of Haifa Metropolis

E. Elimelech*, O. Ayalon, B. Flicstein

Department of Natural Resources & Environmental Management, Faculty of Social Sciences, University of Haifa, Mt. Carmel, Haifa 31905, Israel

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ABSTRACT

The quantity control of hazardous waste in Israel relies primarily on the Environmental Services Company (ESC) reports. With limited management tools, the Ministry of Environmental Protection (MoEP) has no applicable methodology to confirm or monitor the actual amounts of hazardous waste produced by various industrial sectors. The main goal of this research was to develop a method for estimating the amounts of hazardous waste produced by various sectors. In order to achieve this goal, sector-specific indicators were tested on three hazardous waste producing sectors in the Haifa Metropolis: petroleum refineries, dry cleaners, and public hospitals. The findings reveal poor practice of hazardous waste management in the dry cleaning sector and in the public hospitals sector. Large discrepancies were found in the dry cleaning sector, between the quantities of hazardous waste reported and the corresponding indicator estimates. Furthermore, a lack of documentation on hospitals' pharmaceutical and chemical waste production volume was observed. Only in the case of petroleum refineries, the reported amount was consistent with the estimate.

1. Introduction

Hazardous waste (HW) management is a continuous challenge in Israel. Until the 1990s disposal of HW was conducted voluntarily without any obligatory legislative frame. In 1990 the Business Licensing Regulations [1] were promulgated, determining that any HW producer must remove his waste to the treatment and landfilling site at Ramat Hovav.

Despite legislative changes, four major obstructions hinder the good practice of HW management from being achieved.

The first is the fact that the definition of HW in Israeli legislation is vague and the sole requirement of the law is proper disposal. By law, waste is considered hazardous if it contains hazardous substances that are disposed of from a plant [1] where as in developed counties HW is defined based on material characteristics and properties. For example, in the USA, the Environmental Protection Agency (EPA) defines HW based on physicochemical characteristics, viz. corrosivity, flammability (ignitability), reactivity or toxicity, and a set of lists (F-, K-, P- and U-codes) [2].

The second obstruction concerns the gap between official policy and practiced management. The stated Israeli policy, favors treatment methods, such as source reduction and recovery for energy production, over waste disposal (landfill). However, in practice most produced HW is disposed of according to law.

Another barrier is the fact that there is only one authorized site for disposal of hazardous waste. This site is located at Ramat Hovav, in southern Israel. The site location (300 km from the country's major industrial zones) and gate fee (about €300 per ton of organic HW) make disposal very expensive. The combination of these two factors is more than likely to make other (not necessarily legitimate) options of disposal more appealing.

The last major obstacle of HW management in Israel is a result of the complexity of assessing the extent of the problem. Statistics from the Ministry of Environmental Protection (MoEP) [3] indicate that approximately 330,000 tons of HW were produced in Israel during 2006. However, these figures have not been verified and are based solely on reports by the manufacturers themselves (according to the "hazardous substances permits") and the Environmental Services Company (ESC), which operates the Ramat Hovav site. ESC is a government owned company founded in 1990. One of its main activities is operating a treatment plant for hazardous industrial waste at Ramat Hovav.

Due to legal constraints and limited financial and human resources, the Israeli MoEP has inadequate enforcement abilities and limited management means to confirm this data.

Abbreviations: EIPPCB, European Integrated Pollution Prevention and Control Bureau; EPA, Environmental Protection Agency; ESC, Environmental Services Company; HW, hazardous waste; MoEP, Ministry of Environmental Protection; PERC, perchloroethylene; TRI, Toxics Release Inventory; WHO, World Health Organization.

* Corresponding author. Tel.: +972 542445546; fax: +972 4 8249971.
E-mail address: efratelm@gmail.com (E. Elimelech).

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The lack of a reliable methodology to assess the amounts and characteristics of HW is a major obstacle in applying best practice of HW management in Israel. Our study suggests establishing the use of practical indicators, which are needed to identify discrepancies between estimated and reported amounts of waste. A performance indicator is a numerical value used to evaluate factors concerning the function of a process or utility. The development of indicators is based on quantitative measurements or statistics of environmental conditions that are tracked over time [4]. Indicators can reflect the current status of environmental management systems and have an important role in assessing system's situation since they can reveal whether the system is functioning well and in compliance with legal regulations. Indicators can be used to quantify HW generation, treatment, minimization, and recycling and also serve in the promotion of awareness and adoption of cleaner production practice [5].

There is lacking evidence in the scientific literature of a comprehensive study on HW indicators based on sector-specific features. Most studies [6–10] have used employment data in order to estimate HW production rates in different industrial sectors.

Earlier studies have tried to formulate indicators for HW estimation in Israel [7–10]. The first study [7] was conducted prior to legislation of the Licensing of Business Regulations (Disposal of Hazardous Substances), 1990, when no law regarding HW disposal or treatment was in force. It estimated that approximately 28,900 tons of HW were produced during 1989. This study was followed by a HW survey, submitted to the ESC, commissioned to create an overall inventory of waste available for treatment. The survey was based on the average waste production rate per industrial employee (assessment according to Danish statistics) [8]. Its findings indicated that approximately 77,000 tons of HW were produced in 1990. Three years later, Goldshmid [9] conducted another survey in order to evaluate the potential for HW combustion in cement kilns of the Nesher Israel Cement Enterprises Ltd. The results indicated that approximately 50,000–60,000 tons of organic HW were produced annually. The last survey, conducted in 2001 [10], was based on employment statistics. According to this survey, the actual annual amounts are 64,000–87,000 tons higher than the amount reported.

These surveys were conducted over a decade ago, and provided a wide range of assessments, casting doubt on their reliability. In order to better predict and control HW production rates, a reliable methodology is needed.

In general, it is common to distinguish between two kinds of waste producers. The first kind, large industries, such as polymers industry, oil refineries etc., are usually located within central industrial zones, adjacent to population centers. In most cases, these industries are operated by public companies that are committed to stakeholders and obligated to present periodical economic reports. These reports also include data on investments related to environmental issues. The MoEP closely monitors these large industries. Therefore, the assumption is that large industries have an incentive to meet environmental standards and legal liability and as a result, implement state-of-the-art technologies, in order to avoid bad publicity and/or heavy fines. The second kind, small industries, e.g. dry cleaners, metal coating facilities, garages etc. usually located within population centers and in most cases are supervised by the local authorities (e.g. municipal environmental departments). Compared with their large counterparts, small industries are subject to less intensive and less strict enforcement, although, in fact, they may present an equal or even greater environmental hazard, in light of their proximity to residential areas.

2. Methodology

The current research uses unique quantitative indicators based on typical production procedures. The methodology was tested on eight industrial sectors in the Haifa Metropolis. Three case studies are discussed in this paper: oil refineries, dry cleaners, and hospitals. The discussed case studies represent two types of sectors. The first kind, large industries, i.e. oil refineries and the second kind, small industries, i.e. dry cleaners.

The research was comprised of two major stages. The first stage was to design a methodology by identifying typical indicators. The second stage was to compare the estimated quantities of HW and those reported by the factories. Data was collected by intensive literature review, questionnaires, interviews and field observations.

The assumption was that discrepancies would be found between the calculated quantities of HW and those reported. However, since the indicator is basically a predictor, a 30% margin of error was considered reasonable.

For each of the industrial sectors, a unique indicator was identified, based on typical production procedures.

3. Theory

3.1. The case of petroleum refineries

3.1.1. General description

Petroleum refining involves a multistage process in which crude oil is fractionated into liquefied petroleum gas, naphtha, kerosene/aviation turbine fuel, diesel oil, and residual fuel oil [11,12]. Oily materials are the primary source of waste for most refineries and are generated when oil coalesces on solids [13]. Oil refinery waste streams normally fall into three categories: (a) sludge—oily sludge, e.g. tank bottoms, desalter sludge, and non-oily sludge (waste water treatment sludge); (b) other refinery waste, e.g. contaminated soil, spent catalyst, oily wastes, spent caustic, spent chemicals, etc., and (c) non-refining wastes, i.e. domestic, demolition, and construction waste [14,15].

Israel has only two petroleum refineries which were recently privatized—Oil Refineries Ltd. within Haifa Metropolis and Paz Ashdod Oil Refinery Ltd. Oil Refineries Ltd. is one of the largest industries in the Haifa Metropolis. Most of the company's products carry a "Green Label" of the Israel Bureau of Standards, which insures compatibility with environmental standards. The environmental management of the Oil Refineries Ltd. complies with ISO 14001 [16].

3.1.2. Relevant indicators

A comprehensive literature review [12,17] revealed that the quantity of HW resulting from oil refining can be estimated according to the amount of crude oil processed.

According to the California EPA [17], the HW generation rate in 1998 was 1.2 kg per ton of crude oil, while in 2002, the waste generation rate was 36% less—0.8 kg per ton of crude oil. The European Integrated Pollution Prevention and Control Bureau (EIPPCB) [12] suggests a different estimation, according to which the solid waste generation rate equals 0.01–2 kg per ton of crude oil, 80% of which may be considered hazardous due to the presence of toxic organics and heavy metals. The EIPPCB estimate is based on the 1995 CONCAWE report [18] on the 1993 European refinery waste position. The former is outdated, and no longer distributed by CONCAWE. Since the EIPPCB document refers to a wide range estimate, it is a problematic reference. Therefore, the California EPA indicator was adopted for the purpose of the present research. However, based on the assumption that the HW management system in California refineries is much more advanced than their counterpart in